

## CLAIMS

What is claimed is:

1. A system for controlling gas flow from a gas source, through a gas conduit, and to a plasma arc torch during a transition from a cold flow when no arc is present to a hot flow when an arc is present comprising:

a first solenoid in communication with the gas source, the first solenoid having an off position and an on position;

a second solenoid disposed proximate the plasma arc torch and in communication with the first solenoid, the second solenoid having an off position and an on position; and

a bypass circuit in communication with the gas source and the second solenoid, the bypass circuit comprising:

a bypass solenoid having an off position and an on position,

wherein the gas pressure within the gas conduit is controlled by the bypass solenoid to reduce gas flow fluctuations when transitioning from cold flow to hot flow.

2. The system according to Claim 1, wherein the bypass solenoid is in the open position and the first and second solenoids are in the closed positions to increase gas pressure of the gas within the gas conduit.

3. The system according to Claim 1, wherein the bypass solenoid and the first solenoid are in the closed positions and the second solenoid is in the open position to decrease gas pressure of the gas within the gas conduit.

4. The system according to Claim 1, wherein the system is used for plasma gas flow.

5. The system according to Claim 1, wherein the system is used for secondary gas flow.

6. The system according to Claim 1, wherein the system is used for gas pre-flow.

7. The system according to Claim 1 further comprising flow control valve in communication with the gas source and the first solenoid, the flow control valve regulating the flow of gas from the gas source to the plasma arc torch.

8. The system according to Claim 1, wherein the bypass circuit further comprises a pressure regulator in communication with the gas source and the bypass solenoid, wherein the pressure regulator regulates the gas flow to a specific gas pressure within the gas conduit.

9. A system for controlling gas flow from a gas source, through a gas conduit, and to a plasma arc torch during a transition from a cold flow when no arc is present to a hot flow when an arc is present comprising:

a first solenoid in communication with the gas source, the first solenoid having an off position and an on position;

a second solenoid disposed proximate the plasma arc torch and in communication with the first solenoid, the second solenoid having an off position and an on position; and

a pressure transducer in communication with the first solenoid and the second solenoid, the pressure transducer sensing gas pressure of the gas within the gas conduit and causing control signals to be sent to the first solenoid and the second solenoid to control the gas pressure to reduce gas flow fluctuations when transitioning from cold flow to hot flow.

10. The system according to Claim 9, wherein the first solenoid is in the open position and the second solenoid is in the closed position to increase gas pressure of the gas within the gas conduit.

11. The system according to Claim 9, wherein the first solenoid is in the closed position and the second solenoid is in the open position to decrease gas pressure of the gas within the gas conduit.

12. The system according to Claim 9, wherein the system is used for plasma gas flow.

13. The system according to Claim 9, wherein the system is used for secondary gas flow.

14. The system according to Claim 9, wherein the system is used for gas pre-flow.

15. The system according to Claim 1 further comprising flow control valve in communication with the gas source and the first solenoid, the flow control valve regulating the flow of gas from the gas source to the plasma arc torch.

16. A system for controlling gas flow from a gas source, through a gas conduit, and to a plasma arc torch during a transition from a cold flow when no arc is present to a hot flow when an arc is present comprising:

- a first solenoid in communication with the gas source, the first solenoid having an off position and an on position;

- a second solenoid disposed proximate the plasma arc torch and in communication with the first solenoid, the second solenoid having an off position and an on position; and

- a pre-charge circuit in communication with the gas conduit between the first solenoid and the second solenoid, the pre-charge circuit comprising:

- a pre-charge gas source; and

- a pre-charge solenoid in communication with the pre-charge gas source, the pre-charge solenoid having an on position and an off position,

wherein the gas pressure within the gas conduit is controlled by the pre-charge solenoid to reduce gas flow fluctuations when transitioning from cold flow to hot flow.

17. The system according to Claim 16, wherein the pre-charge solenoid is in the open position and the first and second solenoids are in the closed positions to increase gas pressure of the gas within the gas conduit.

18. The system according to Claim 16, wherein the pre-charge solenoid and the first solenoid are in the closed positions and the second solenoid is in the open position to decrease gas pressure of the gas within the gas conduit.

19. The system according to Claim 16 further comprising flow control valve in communication with the gas source and the first solenoid, the flow control valve regulating the flow of gas from the gas source to the plasma arc torch.

20. The system according to Claim 16, wherein the pre-charge circuit further comprises a pressure regulator in communication with the pre-charge gas source and the pre-charge solenoid, wherein the pressure regulator regulates the gas flow to a specific gas pressure within the gas conduit.

21. A method of controlling gas flow within a gas conduit for a plasma arc torch prior to arc ignition, the method comprising the steps of:

(a) setting a first solenoid and a second solenoid to an off position and setting a gas pressure within a bypass circuit; and

(b) setting a bypass solenoid to an on position,

wherein the gas pressure within the gas conduit between the first solenoid and the second solenoid is controlled to overcome gas flow fluctuations during a transition from a cold flow when no arc is present to a hot flow when an arc is present.

22. The method according to Claim 21, wherein the gas pressure is increased.

23. The method according to Claim 21, wherein the gas pressure is decreased.

24. A method of controlling gas flow within a gas conduit for a plasma arc torch prior to arc ignition, the method comprising the steps of:

(a) setting a first solenoid and a second solenoid to a closed position;

(b) sensing a gas pressure within the gas conduit between the first solenoid and the second solenoid; and

(c) sending control signals to the first solenoid and the second solenoid to control the gas pressure within the gas conduit.

25. The method according to Claim 24, wherein a control signal is sent to the first solenoid to open when the gas pressure is below an established value.

26. The method according to Claim 24, wherein a control signal is sent to the second solenoid to open when the gas pressure is above an established value.



27. A method of controlling gas flow within a gas conduit of a plasma arc torch during a transition from a cold flow when no arc is present to a hot flow when an arc is present, the method comprising the step of controlling the gas pressure within a gas conduit prior to arc ignition to a desired pressure level to reduce gas flow fluctuations when transitioning from cold flow to hot flow.